

being superseded in many minds by Chamberlin's planetesimal theory, after having inspired petrologists with a vain hope of finding traces of the primeval slaggy crust among the Archæan gneisses. Astronomers prefer a solid globe, but on grounds different from those assumed by Hopkins and at first accepted by Lord Kelvin. Arrhenius concludes in favour of a gaseous core, like that postulated by Ritter, but of larger dimensions than the gaseous core suggested by Dr. Wilde.

Theories regarding the processes of consolidation, the gradient of pressure, and the deep-seated rise in temperature are equally varied. Until this year all agreed in assuming the earth's interior to be hot, but Prof. Schwarz now prefers to think it is cold. So long as radio-active bodies were unknown the apparent reserves of heat-energy offered the world a short life; but its actuarial value has now been increased almost indefinitely by the discovery of radium in embarrassingly large quantities, and Prof. Joly warns us that, instead of peaceful cooling, the present "age" may end in catastrophic heating.

The nearest approach to actual observation regarding the deep-seated parts of the globe is recorded by the seismograph as interpreted by R. D. Oldham, who aptly compares the seismograph with the spectroscope as an instrument for examining inaccessible objects. The first and second phases of long-distance seismographic records, which are due to waves passing through the earth by approximately chordal paths, show a reduction in velocity when there is a sufficient distance between the origin of the shock and the recording instrument for the assumed chordal paths to pass through the inner two-fifths of the earth's core, while the distortional waves are apparently dispersed by refraction when the origin of the earthquake and the recording instrument are separated by about  $140^\circ$ . The records, which are confessedly too few to be regarded as conclusive, suggest that the central core differs in physical characters from the outer three-fifths and the superficial crust. Similarly, the vibrations that pass under the great oceanic depressions indicate elastic conditions differing from those under the continental plateaux, the difference being apparent to a depth of about one-quarter the earth's radius. This last conclusion might be correlated with the variation in the chemical composition in the sub-oceanic crust caused by selective denudation of the kind indicated by Sir John Murray in 1899, and by Chamberlin's theory regarding the origin of the oceanic depressions.

The recent discussions and new data obtained by geodesists and geologists to check Dutton's theory of isostasy have revived interest in the deep-seated parts of the superficial crust. The remarkable work recently done in India by Burrard and Lenox-Conyngham, when correlated with the results of the Geological Survey, are especially important in showing the truth and the limitations of isostasy. Burrard's results indicate that the Himalayan heights are partly compensated by deficiencies of subterranean gravity, and that greater loads are maintained by the rigidity of the geologically stable crust of the peninsula than in the folded parts of the extra-peninsular region. The deficiency of gravity under the outer and sub-Himalaya is, however, equally pronounced in the plains near the southern foot of the range; but at a distance of about 150 miles from the foot of the mountains there is a subterranean band of high gravity parallel to the alluvium-filled Gangetic valley, as well as to the four Himalayan zones—the foot-hills, composed of Tertiary strata; the outer Himalaya, of much older, unfossiliferous sediments; the crystalline range of snow-covered peaks; and the Tibetan highlands of fossiliferous, marine strata.

Soon after Dutton published his theory of isostasy, R. S. Woodward pointed out that, if the highlands continued to rise in consequence of the reduction in their load by erosion, and the depressions continued to sink under the growing weight of accumulating sediment, the process should continue indefinitely, and mountain ranges would thus never be worn down, while new folds in undisturbed areas would never arise; but the geological history of India shows why and how this process may result in "isostatic suicide." For ages before the end of the Mesozoic era the rivers of Gondwanaland, which stretched away as a great continent to the south and west, poured

their loads of silt into the Eurasian ocean, of which the southern shore-line approached the line now occupied by the Himalayan snow-covered peaks. With the loading down of the northern littoral of Gondwanaland, the northern part of the continent became stretched, and normal faults were developed with a general east to west trend.

Some of the faults of this kind occurring in the Central Provinces were shown by J. G. Medlicott, so long ago as 1860, to be pre-Gondwana (that is, pre-Carboniferous) in age, others were formed before the Upper Gondwana (Lower Mesozoic) strata were formed, while the latest affected the younger Gondwana beds, and became channels for the Upper Cretaceous basalts. The general trend of the Cretaceous dykes in this part of India, and the prevalence of normal faults further east at about the same latitude, shown in various geological maps published by later members of the Geological Survey, indicate the nature and direction of the tension produced by the unloading of Gondwanaland and the simultaneous depression of the adjoining ocean bed. The process reached its climax towards the end of Cretaceous times, when the basaltic magma below welled out and flooded more than 200,000 square miles to a depth of nearly a mile.

Presumably the tension marked by faults in Central India existed also in areas further north, where the records are now buried under the Gangetic alluvium, and the band of high gravity detected by Burrard's plumb-line and pendulum is probably due to concealed batholiths of basic and ultra-basic magma, which were injected into the region of tension after the manner described by Prof. R. A. Daly.<sup>1</sup> Then followed the production of a geosyncline parallel to the northern shore-line of the old Gondwana continent and parallel to the subsequent folds of the Himalayan range, which are now being thrust over towards the region of deficient gravity between the visible mountain range and the concealed band of basic batholiths.

The data in this area are in substantial agreement with Daly's idea of a persistent sub-crustal gabbroid magma, which, though possibly only in a state of potential fusion under regions of normal pressure-gradient, may become fluid in localities of protracted erosion and gradual rise of the northern shore-line of the old Gondwana continent and agree, in general, with those analysed by Hayford and others in America in showing that isostasy can be detected only when the visible masses over wide areas are concerned; further data of this kind will permit of the determination of the minimum loads that can be maintained by the crust in old stable land surfaces as compared with the apparently smaller loads maintained in recently folded regions. If the sequence of events in India has been correctly traced, it should be possible to indicate areas on the earth which are in danger of basaltic floodings and of later folding movements. In South America, for instance, the north-flowing tributaries of the Amazon and the Araguaya are possibly developing conditions on the old land surface of Brazil similar to those that on Gondwanaland preceded the outburst of the Deccan Trap in Cretaceous times.

#### THE HULA, OR FOLK-DRAMA OF HAWAII.

THE Hula, or national folk-drama of Hawaii, has already been casually described by the Rev. W. Ellis in his "Polynesian Researches," and has been noticed in the "Travels" of Captain Cook; but it was left to Dr. N. B. Emerson to undertake a detailed investigation of the unwritten literature of the island, and to make a collection of the songs sung in these performances. The results of this study have been published in Bulletin No. 38 of the American Bureau of Ethnology. We may congratulate this institution on having now, for the first time, under the authority of a special Act of Congress, extended its operations beyond the bounds of the American continent.

The Hula is a special form of folk-drama, dealing in a series of impassioned lyrics with many phases of the national mythology and traditions. The poetry is of a highly romantic and sensuous type, including themes connected with human love and life, the processes of nature,

<sup>1</sup> "Abyssal Injection as a Causal Condition and as an Effect of Mountain-building," by R. A. Daly (*Amer. Journ. Sci.*, xxi., 1906, pp. 207-13).

the mysteries of the spirit world, described by a series of metaphors and personifications. Much of it is of very ancient date, and is hardly intelligible even to the best native scholars at the present day. In studying the translations and analysis of Dr. Emerson, we cannot avoid the suspicion that much is vague and uncertain, and that the interpretations may sometimes ascribe to these apparently meaningless songs a significance which reflects modern romantic conceptions alien to the spirit of the early singers. Throughout the whole drama the themes are essentially religious. The chief deity invoked is Laka, the impersonation of the powers of vegetation, who is addressed in special hymns and worshipped at an altar adorned with leaves and flowers of those plants which are believed to be specially acceptable to the goddess, because they are the forms in which she prefers to manifest herself. With her are invoked the spirits of the wood, which resemble the fairies of Europe, Pele, the goddess of the volcano, and her sister, Kapo, who, like the Mother goddesses in other parts of the world, assumes a dual form—benevolent as a sylvan deity, chthonic or lewd, the latter phase being only occasional.

As Mr. A. Lang has pointed out, the mysteries of Greece



Woman playing on the Nose-flute (Ohe-lano-ihu).

can best be interpreted on the analogy of rites among savage or semi-savage races. The Hula accordingly presents notable resemblances to the Greek Eleusinia and similar celebrations. The performers are carefully selected; they must observe stringent purity tabus, sexual license being prohibited; they are kept in a special enclosure, which they must never leave except with muffled heads, and they must engage in no conversation beyond its limits; above all things, they must avoid contact with a corpse. As the Greek hierophant proclaimed, "Ye mystae, to the sea!" in Hawaii the performers rush into the ocean, going and returning in a state of nudity; there is a pass-word of admission, a prayer at the beginning and end of each performance, and a special supplication for the removal of tabu; a ritual dress, modelled on the primitive fig-leaf. Finally, the central act of the rite is a form of sacrament. A cooked pig is brought into the assembly, and the hierophant, acting as carver, "selects the typical parts—snout, ear-tips, tail, feet, portions of the vital organs, especially the brain (*lolo*). This last it is which gives its name to the ceremony. He sets an equal portion before each novitiate. Each one must eat all that is laid before him. It is a

mystical rite, a sacrament; as he eats he consciously partakes of the virtue of the goddess that is transmitted to himself."

The Hula assumes various forms. A special type is assigned to each instrument—the drum, the gourd rattle, the bamboo rattle, a kind of xylophone, pebble castanets, a hollow bamboo beaten on the ground, a jew's harp, and that remarkable instrument the nose-flute. Others include the use of marionettes, or mimetic delineations of animals, as the shark and dog dances.

On the whole, this elaborate study of a primitive folk-drama is interesting from many points of view—as a description of savage music recorded in the recognised notation; as throwing fresh light on the problem of the mysteries; as a new conception of folk-poetry, with its sensuous, enigmatic lyrics. Lastly, it throws novel light on the interpretation of the popular mythology and traditions. If we cannot always accept Dr. Emerson's interpretations of the materials which he has collected, we can admire the industry and insight which appear throughout this volume.

#### PIGMENTATION AND CANCER.

DOES the absence of skin pigment predispose white men to cancer? This question has been answered in the affirmative in a paper<sup>1</sup> which has attracted some attention. The author, Dr. Watkins-Pitchford, adduces instances of the inverse ratio obtaining between the degree of pigmentation of the skin and of the body cavity, and explains that the external and internal pigmentations protect the tissues from excessive "irradiation" by actinic rays, of which the influence is assumed to be highly inimical to the life of the individual. More weight would have attached to his observations, in whatever bearing they have upon cancer, had the thickness of the body wall been considered in relation to the degree of internal pigmentation and the slight penetrating powers of many of the rays loosely called actinic.

"White man is of all animals the most liable to cancer" forms the postulate from which the author elaborates his views. This is an old dogma which is by no means universally accepted as true, and for certain individual organs is now proven to be false. For example, cancer of the mamma is probably as frequent in Indian hospitals as it is in London, and it is as common in the mouse as it is in the human female. It certainly occurs in the native African negress more frequently than was formerly supposed. However, the author brings this first postulate into line with his second, "the absence of effective pigmentation, or other form of external protection, in white man is the primary cause of his liability to cancer"; the same holds for domesticated animals. The liability to cancer should therefore be found increasing in proportion as pigmentation is decreasing, and the true albino of any species, man included, should display the greatest liability of all. A table is given to illustrate the scale of liability of black, brown, red, yellow, and white races of man by estimations of "probable" cancer death-rates for Zulus, Tamils, Red Indians, Chinese, Italians, English, Dutch, and Swedes. The figures can be definitely stated to be worthless for purposes of comparison. Those for the Chinese in the United States are meant to show the intermediate incidence of cancer in the yellow race; but why not have chosen the Japanese, who have relatively excellent national statistics showing more than 25,000 deaths annually, and who admit that this number is far short of the total, which would represent a death-rate probably not less than in England? The Italian figures presumably represent "brown" man, but the Italian national statistics are among the worst in Europe, and cannot be compared with English statistics. The table merely gives a list of increasingly worthless figures and correspondingly untrustworthy records of the occurrence of cancer. The argument would, however, break down for another reason—by its failure to explain the frequency of cancer in the negroes of America as contrasted with its real or apparent infrequency in Africa.

<sup>1</sup> "Light, Pigmentation and New-growth, being an Essay on the Genesis of Cancer." By Dr. Wilfred Watkins-Pitchford. Pp. 150. Read at the South African Medical Congress, Durban, August 2, 1909.